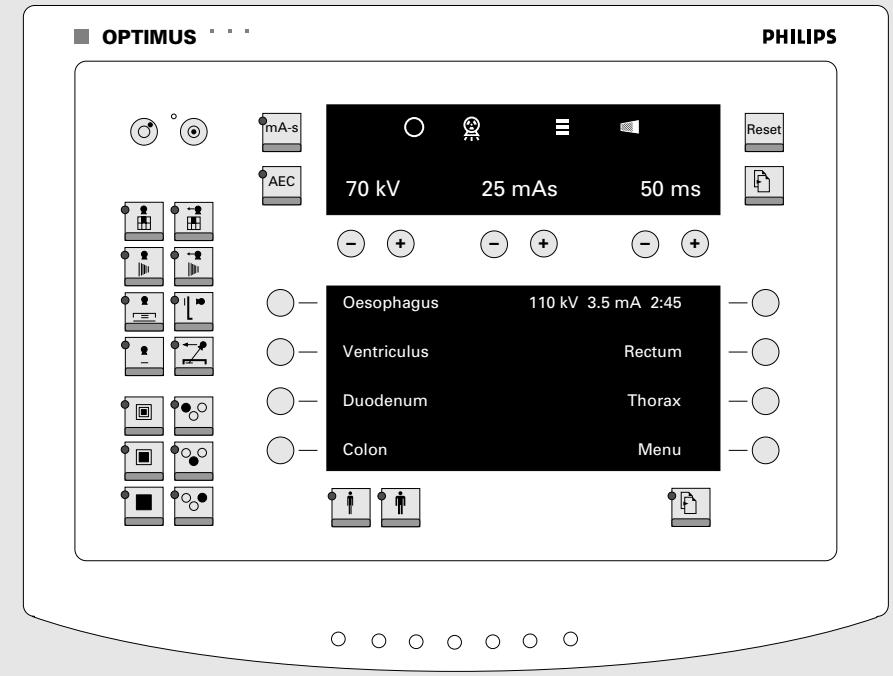
Radiography



INSTRUCTIONS FOR USE

OPTIMUS 50/65/80

X-RAY GENERATOR

VERSION 3.5

English

PHILIPS

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1 Safety

This manual is intended to ensure safe work using the X-ray generator described. You may operate the X-ray generator only in compliance with the safety instructions in this manual and you must never use it for purposes other than those for which it was designed. It is part of an X-ray unit which may only be operated by personnel who have the necessary expertise in radiation protection or have knowledge of radiation protection and have received instruction on how to operate the X-ray unit.
It is always the user who is responsible for compliance with the regulations applying to the installation and operation of an X-ray unit.

- You must never use the X-ray unit if it has any electrical, mechanical or radiological defects. This particularly applies to faulty indicators, displays, warnings and alarms.
- If the user wishes to connect the X-ray unit to equipment, components or assemblies other than those described in the section "Compatibility" and if it is not apparent from the technical data whether it can be safely combined with such equipment, components or assemblies, the user must ensure that the safety of the patient, operating staff and the environment is not affected by the planned combination by consulting the manufacturers involved or by making enquiries from an expert.
- Philips is responsible for the safety features of its products only if maintenance, repairs and modifications have been performed by Philips or by persons explicitly authorised to do so by Philips.
- As with any technical appliance, this X-ray equipment requires not only correct operation but also regular, competent maintenance and care, which are described in the section "Maintenance".
- If you operate the X-ray equipment incorrectly or if the user fails to have maintenance carried out properly, Philips cannot be held liable for any malfunctions, damage or injuries.
- Safety circuits may be neither removed nor modified.
- You may only remove or open parts of the housing if you are instructed to do so by this manual.

1.1 Electrical safety

This X-ray generator conforms to safety class I.

Only trained staff may remove the covers from the X-ray generator.

- You must never operate the equipment in areas where there is a risk of explosion.
- Detergents and disinfectants, including those used on patients, may create explosive mixtures of gases. Please observe the relevant regulations.

1.2 Radiation protection

Ensure that before every X-ray exposure/ fluoroscopy all the necessary radiation precautions have been taken. For information about radiation protection measures refer to the Instructions for use for the individual pieces of X-ray equipment which you are operating with this generator.

Safety circuits which prevent x-radiation from being switched on under certain conditions must never be removed or modified.

1.3 Disposal

Philips manufactures X-ray equipment based on the latest standards of safety and environmental protection. Provided no parts of the system housing are opened and provided the equipment is handled properly there are no dangers to persons or the environment.

To comply with regulations it is necessary to use materials which may be environmentally harmful and have to be disposed of properly.

For this reason, never dispose of the X-ray equipment together with normal industrial or household waste.

Philips
- assists you in disposing of the described X-ray equipment properly
- returns reusable parts to the production cycle via certified waste disposal companies and
- thus helps to reduce environmental pollution.

Contact your Customer Service in complete confidence.

1.4 Conformity

This Medical Device meets the provisions of the Medical Device Directive 93/42 EEC (93).

If you have further questions regarding the applicable national or international standards, please address them to:

Philips Medical Systems DMC GmbH
Qualitaetssicherung
Roentgenstrasse 24
D-22335 Hamburg
Fax: (+49) 40/50 78-21 47

1.5 Copyright

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This manual is a translation from the German. The original version has the code number 4512 109 24962.

In taking receipt of the data media the user acquires a non-exclusive, non-transferrable right to use the software stored on them in conjunction with the hardware components supplied for it by Philips.

Modifications to software, using it on hardware components other than those supplied by Philips in this connnection (multiple use) and the making of copies, even for the purposes of data backup, must be approved by Philips in writing beforehand.

1.6 Normal use

With the OPTIMUS generators you can perform fluoroscopy and make diagnostic X-ray exposures within the scope of their technical data and descriptions.

1.7 Electromagnetic compatibility (EMC)

In accordance with its intended use, this electronic apparatus complies with the law governing EMC, which defines the permitted emission levels from electronic equipment and its required immunity against electromagnetic fields.

Nevertheless, it is not possible to exclude with absolute certainty the possibility that radio signals from high-frequency transmitters, e.g. mobile phones or similar mobile radio equipment, which themselves conform to the EMC regulations, may influence the proper functioning of electromedical apparatus if such equipment is operated in close proximity and with relatively high transmitting power. Therefore, operation of such radio equipment in the immediate vicinity of electronically controlled medical apparatus should be avoided to eliminate any risk of interference.

Explanation:
Electronic apparatus that satisfies the EMC requirements is designed so that under normal conditions there is no risk of malfunction caused by electromagnetic interference. However, in the case of radio signals from high-frequency transmitters with a relatively high transmitting power, the risk of electromagnetic incompatibility when operated in close proximity to electronic apparatus cannot be totally ruled out.

In unusual circumstances unintended functions of the apparatus could be initiated, possibly giving rise to undesirable risks for the patient or user.

For this reason, all kinds of transmission with mobile radio equipment should be avoided. This also applies when the apparatus is in "standby" mode.

Mobile telephones must be **switched off** in designated problem zones.

2 Description

2.1 The function

This generator produces the voltages and currents required for operating an X-ray tube and makes the supply voltages available for parts of the X-ray system as a whole.

2.1.1 What the generator is capable of

In the following table you can see what configurations offer what exposure techniques:

Radiography and fluoroscopy techniques	**Configuration**			
	Basic version without APR, AEC	with APR without AEC	with AEC without APR	with APR and AEC
kV technique	–	–	+	+
kV-mA technique	–	–	–	+
TDC	–	–	–	+
kV-mAs technique	+	+	+	+
kV-mA-s technique	+	+	+	+
kV-mAs-s technique	–	+	–	+
Special exposure for therapy simulation	–	+[3]	–	+[3]
Fluoroscopy	+[1]	+[2]	+[1]	+[2]

+ possible
– not possible

[1] only a kV-mA characteristic is possible
[2] Customer Service can assign different kV-mA characteristics to the various APRs
[3] Fluoroscopy must be available

2.1.2 Possible configurations:

- Basic version
- Also with AEC (optional)
- Also with APR (optional)
- Also with AEC and APR (optional).

This Operator's Manual describes all the configurations.

2.1.3 Functions of the maximum configuration:

- Exposure techniques
  – APR with automatic exposure control (AEC)
  – APR without automatic exposure control
- Techniques with automatic exposure control (AEC)
  – kV technique
    – with maximum tube power according to the focal spot selected or
    – with fixed current within the adjustable values
    – tomography (TDC)
- Techniques without automatic exposure control
  – kV-mAs technique
  – kV-mA-s technique
  – kV-mAs-s technique

2.1.4 Other functions

- Change exposure data of an APR programme
  – for the next exposures (without saving)
  – with saving afterwards
- Save up to 1,000 APR programmes
- Adapting the exposure data to the thickness of the patient's body
- Area dose product (optional, depends on system)
- VARIOFOCUS (optional)
  With the VARIOFOCUS function you can select a focal spot the properties of which are between the large and small focal spots. The ratio of the two focal spots is stated as a percentage of the small focal spot.
  "20% SF" means 20% weighted power of the small focal spot and 80% weighted power of the large focal spot.
  The VARIOFOCUS is set for each APR programme during installation.

2 Description

2.2 What's new?

This Operator's Manual describes the generator with all possible functions at the time of going to press. Relevant for the functions available in the generator is the acquired or upgraded configuration. This Operator's Manual also describes all the earlier generator versions. The following table informs you about all possible functions.

Function	from version	Option
AEC (Automatic Exposure Control)	1	+
Automatic Tomo time input	1	+[2]
APR (Automatically Programmed Radiography)	1	+
APR extension	2	[2, 5]
Display of area dose product	2	+[1]
VARIOFOCUS	2	+[2]
Display of thermal state of tube assembly	2	+[4]
TDC (Tomography Density Control)	2	+[2, 6]
kV technique with fixed current	2	+[2, 6]
PDO (Patient Data Organizer)	2	+[3]
Fluoroscopy	3	
Special exposure for therapy simulation	3	+[2, 7]
Photomultiplier adapter	3	+[6]

[1] compatibility depends on the system
[2] only with APR
[3] see Operator's Manual for PDO
[4] depending on the system and tube assembly
[5] always included (without control module)
[6] only with AEC
[7] only with fluoroscopy

2.3 What you have to know before switching on

- Please observe the instructions on safety and maintenance.
- If a button
  – is lit: the function or the auxiliary is activated.
  – is not lit: the function or the auxiliary is deactivated.
- If you reach a limit, the display goes out briefly and reappears.
- If you change a value and this causes a change in the mAs value, for example, the new value will be indicated.
- If you wish to change a non-variable value, the value is retained, whilst the display goes out briefly and reappears.
- After the end of an exposure there is an audible signal and the actual exposure data appear for 25 s as a post-exposure display or until the next operator action only with AEC. With you can call up the post-exposure display again provided you have not released any new exposure.
- You can make up to three exposures a minute in any sequence. **When doing so it is absolutely essential that you observe the tube assembly status display and the information contained in the Instructions for Use delivered with the tube assembly.**
  If you attempt to make a fifth exposure within one minute, it will not be released. The generator prevents any further exposure for one minute.
  Exceptions:
  There is no limitation to four exposures per minute
  – if you release fluoroscopy within one minute and before the fourth exposure at the latest or
  – in the serial mode.

  For pediatric exposures please read the note on page 10.

2.4 Monitoring system for conditions for shutting down radiography

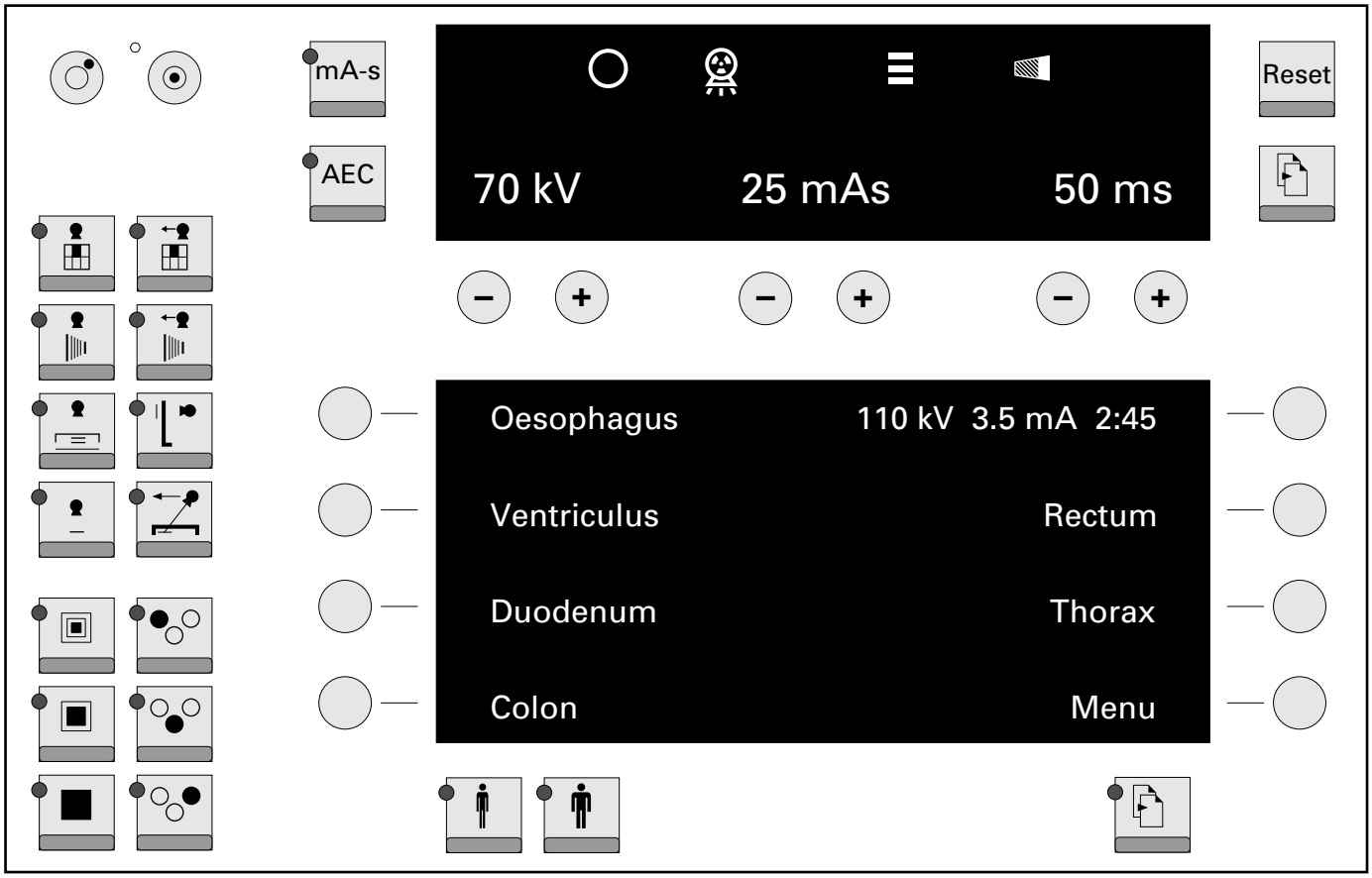
The generator has a monitoring system which **in the event of an error** protects against uncontrolled radiation, within the scope of foreseeable possibilities. **With radiography using automatic exposure control** this monitoring system interrupts the radiation if any of the following conditions is met:

Stage 1: If the mAs value has reached 9.5 times the mAs value of the type of exposure selected
Stage 2: If after 10% of the maximum permissible exposure time at least 4% of the expected switch-off dose has not been reached
Stage 3: If 600 mAs or 4 s has been reached. The value of 600 mAs can be set lower by the Customer Service.

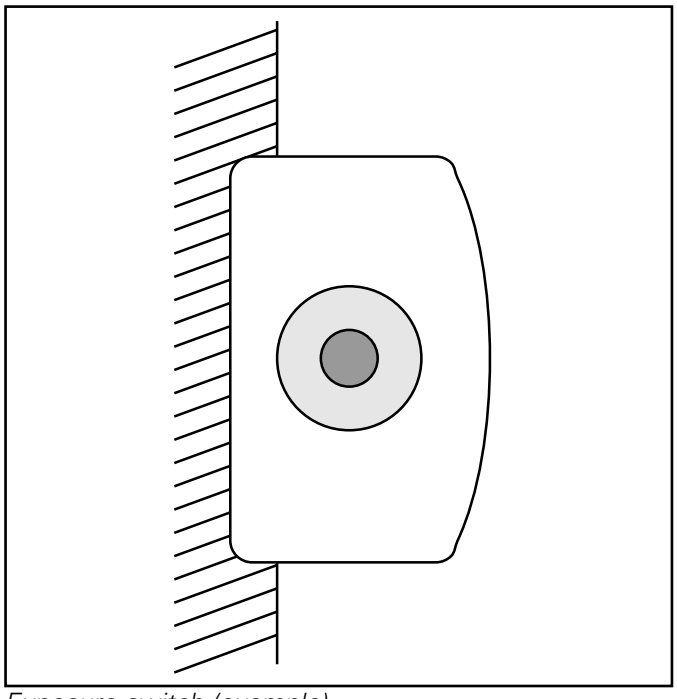
If you change an APR programme temporarily, stages 1 and 2 switch off. This will be displayed by an asterix „*" (see section 4.4.4). Stage 2 remains activated for these 10% of the maximum exposure time, even stage 3 remains activated. If you wish to accept the changed programme as a fixed programme, you must enter the mAs values to be expected via the mAs technique in order to adapt stages 1 and 2 to the new programming (for reference you will find an exposure table in the Appendix). Then stages 1 and 2 are reactivated.

3 Legend

This legend describes the maximum configuration of the X-ray generator.



Control desk (the displays illustrated are examples)



Exposure switch (example)

The exposure switch is a two-step switch.

Step 1: Preparation - The green Ready indicator goes out.
When it lights up again:

Step 2: Release exposure.

You can press the button straight through to the second position. After the preparation time the exposure is released. **Keep the button pressed until the end of exposure or else the exposure will be aborted. Never press the button more than three times in one minute. In this way you will extend the life of the X-ray tube.**

Specially for paediatric exposures and casualty departments, for example, Customer Service can program the preparation time to 30 s for each tube selected. Preparation remains on even after letting go of the exposure button from the "Preparation" stage, provided no exposure has been released.
After exposure, preparation is switched off.

3.1 What the display panels tell you

Green Ready lamp: ready to make an exposure

Radiation is switched on

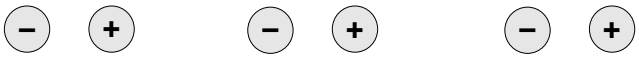
Display of tube assembly state
(Please also observe the instructions in the instructions for use for the X-ray tube assembly):

Green:	Full power available
Amber + green:	The tube assembly is warm, full power is available
Amber:	Up to 80% of full power is available
Amber + red:	Up to 64% of full power is available
Red:	The thermal safety switch in the tube assembly is activated – radiography not possible – fluoroscopy current is limited to 3 mA

Incorrect exposure indicator; if it flashes
you have let go of the exposure switch prematurely; press Reset
or
the limit of exposure time or mAs has been reached; press Reset
or
the exposure has been aborted owing to incorrect exposure (incorrect exposure early warning system), press Reset .

3.1.1 Display in the exposure data panel with AEC: kV, kV-mA and TDC techniques

(Display on the first level, example)



Display and selection of
– exposure voltage
– density correction at SFC only (at radiography with image intensifier only display)
– screen-film combination (SFC, not for radiography with image intensifier)

Post-exposure display
(Display on the second level, example)

The values of post-exposure display are marked by a triangle.

3.1.2 Display in the exposure data panel for the kV-mAs or kV-mAs-s technique:

(Display on the first level, example)

Display and selection of
– exposure voltage
– mAs product
– exposure time (selection only possible for kV-mAs-s technique)

3.1.3 Display in the exposure data panel for kV-mA-s technique

(Display on the first level, example)

Display and selection of
– exposure voltage
– exposure current
– exposure time

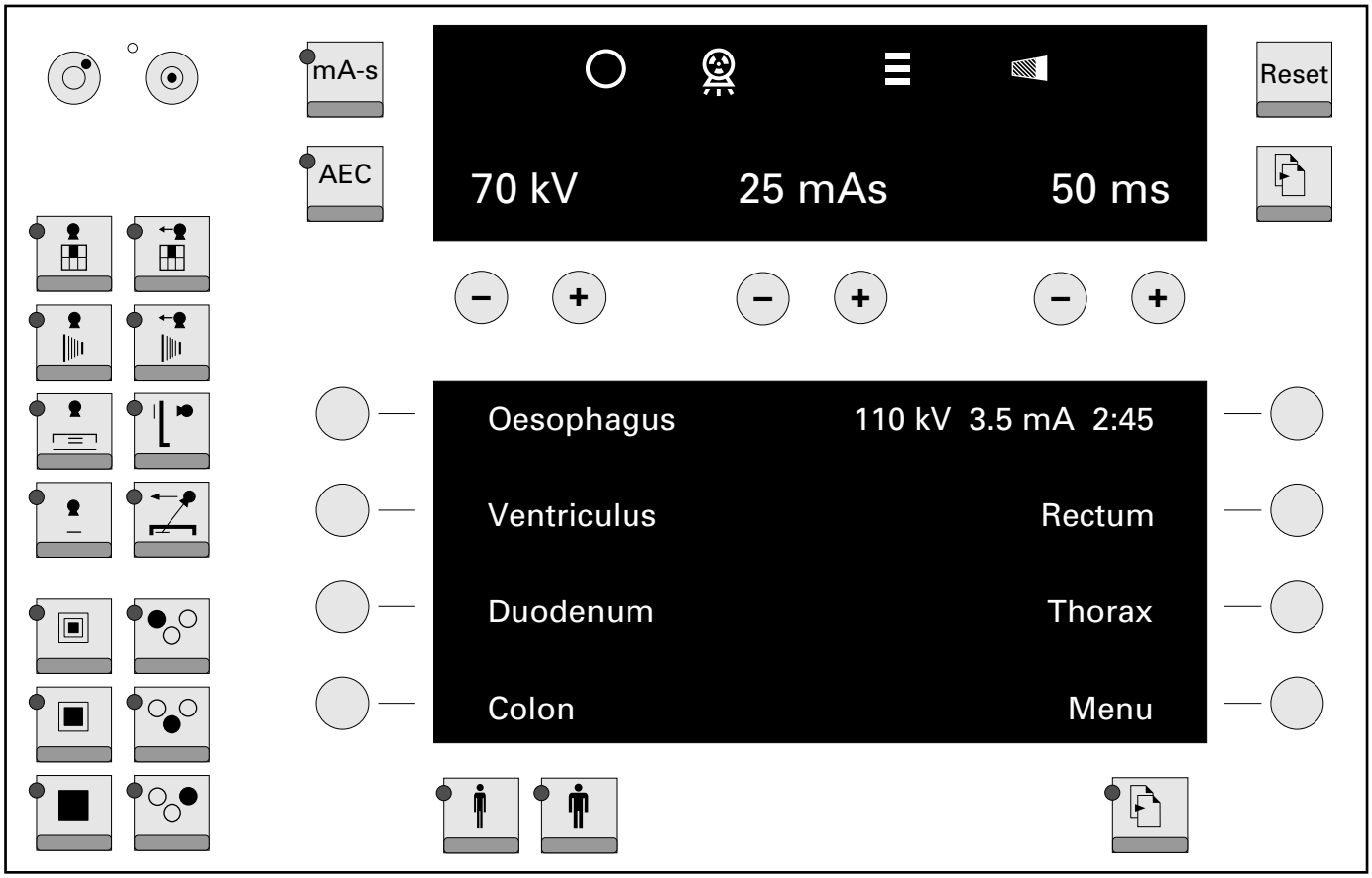
3.1.4 Change exposure data

– in steps: press ⊖ or ⊕ briefly
– continuously: press ⊖ or ⊕ longer

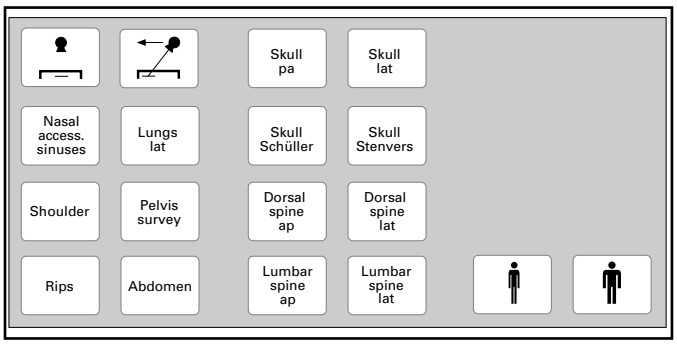
As an alternative to exposure data, error messages or instructions appear for the operator. For more information refer to the Appendix.

For information about the displays on levels 2, 3 and 4 refer to section 8.2.

3 Legend



Control desk (the displays illustrated are examples)



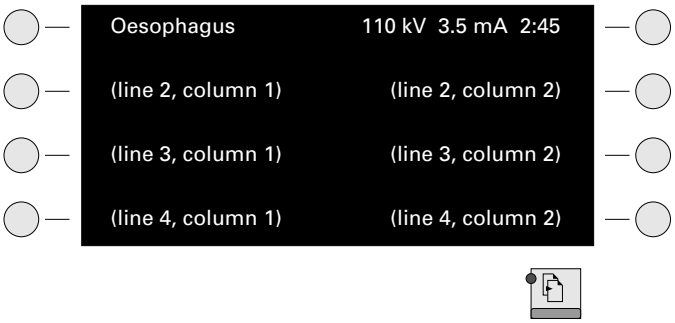
Optional keypad module, depending on system (example)

Optional keypad module (APR assignment, maximum configuration, depending on the system)

The 18 buttons on an optional keypad module are assigned as follows:

- 14 buttons for APR programmes, each button can be assigned any auxiliary
- 2 buttons for selecting the auxiliairies
- 2 buttons for adjusting exposure data to the thickness of the patient's body

3.1.5 Central display panel



APR programmes, display and selection; the APR programme selected appears highlighted. If there is an APR menu, "Menu" appears on line 4, column 2. You can call it up with the button ◯ .

With you can scroll through the pages if the LED is lit and at least two pages have been programmed. After the last page, page 1 appears again.

If, after scrolling, you press the exposure switch on "Preparation" the following appear:
the APR programme last selected
the appropriate exposure data.

If you have modified the data of a programme, an asterisk appears after the name of the programme. The modified data remain intact (even if you change the auxiliary for example) until you select the same programme again or a different one.

3.2 The buttons and their functions

Switch generator OFF

Switch generator ON

Switch between kV-mA-s technique (LED lit) and kV-mAs-s technique or kV-mAs technique (programmable alternatives)

Switch automatic exposure control ON/OFF

– Switch incorrect exposure indicator OFF
– Save modified APR data together with an APR button
– Clear error message
– New patient (PDO, optional)
– Switch OFF audible signal after 5 min of fluoroscopy

Call up different levels on the display

Select focal spot:

Small focal spot

VARIOFOCUS (optional)

Large focal spot, standard selection for single-focus tubes

Select measuring field(s) of the automatic exposure control (AEC). In the case of radiography with AEC on image intensifier (II) only the centre measuring field is illuminated. On systems with size sensing you can only select the outer measuring fields if the cassette is inserted.

Adapt exposure data to the thickness of the patient's body:

Slim patient

Stout patient

Select auxiliaries (examples):

Spot-film device

Spot-film device, tomography

DSI

DSI, tomography

Angiography with Puck

Wall column

Free cassette

Tomography attachment

Bucky

For further information about the button symbols refer to section 8.4.

4 Operation

4.1 Operation of all configurations

4.1.1 Switching the generator ON/OFF

What you have to do …	**… and what happens**
◎ Switch generator ON	The generator performs a self-test: • All the lamps and display segments light up briefly. • There is an audible signal. During this test you should check the following: • Do all the lamps and display segments light up? • Is there an audible signal? If a fault occurs, please call the Customer Service. If an error message appears, you will find help in section 8.1. After the self-test the generator assumes the state as it was before the equipment was last switched off.
Before you switch off the generator: **Wait for 1 min** after an exposure or after pressing the preparation button so that the rotating anode can decelerate; **in an emergency switch off immediately.** Switch off the generator	The generator and all the connected auxiliaries are switched OFF.

4.1.2 Setting display brightness

Press the buttons in the order indicated in the description below and keep them pressed for as long as you wish to change the brightness.

Display
– of exposure data panel
– of the APR indicator not selected
– possibly of the fluoroscopy indicator

Reset and **mAs** ⊖ ⊕ or **mA** ⊖ ⊕ — With ⊖ brightness is reduced and with ⊕ it increases.

Display
– of the APR programme selected (highlighted)

Reset and **kV** ⊖ ⊕ — With ⊖ brightness is reduced and with ⊕ it increases.

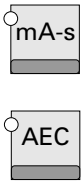
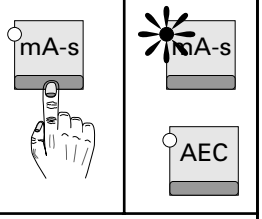
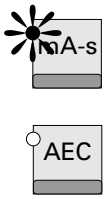
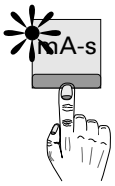
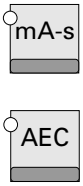
4.2 Operation of the basic configuration

4.2.1 Exposure techniques

The following exposure techniques are available:

– kV-mAs technique
– kV-mA-s technique

The table on the right shows how to switch between the individual techniques.

<table>
<tr><th rowspan="2">Initial state</th><th colspan="3">Switch over to</th></tr>
<tr><th colspan="2">kV-mAs</th><th>kV-mA-s</th></tr>
<tr><td>kV-mAs
  </td><td colspan="2"></td><td>  </td></tr>
<tr><td>kV-mA-s
  </td><td>  </td><td>  </td><td></td></tr>
</table>

4.2.2 Making X-ray exposures

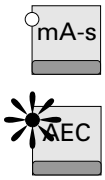
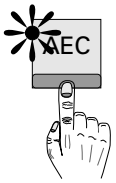
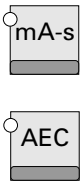
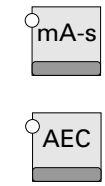
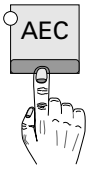
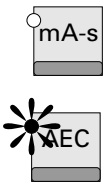
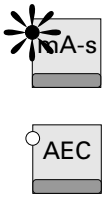
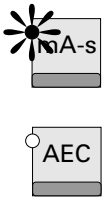
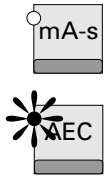
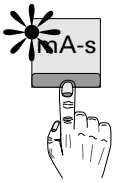
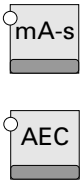
What you have to do …	… and what happens
Select auxiliary	• The LED is lit
Select focal spot only while two focal spots are available and VARIOFOCUS (optional)	
Enter exposure data	• 70 kV 25 mAs 50 ms (Example)
If necessary, adapt exposure data to the thickness of the patient's body	• Depending on programming by Customer Service kV and mAs are adapted in dose-equivalent increments for each auxiliary.
Position patient	
Collimate!	
Release preparation (step 1)	• goes out briefly
Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• is lit • Preparation/exposure or fluoroscopy can also be indicated visually (optional)
You can also press the button straight through to step 2. After the preparation time the exposure is released.	After exposure • There is an audible signal • goes out • The exposure data remain intact

4.3 Operation with AEC, without APR

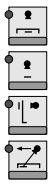
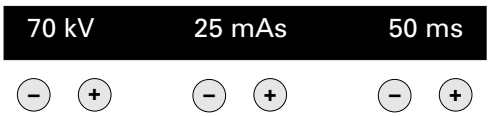
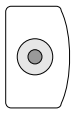
4.3.1 Exposure techniques

The following exposure techniques are available:
– kV technique
– kV-mAs technique
– kV-mA-s technique

The table below shows you how to switch between the individual techniques:

Initial state	Switch over to		
	kV	***kV-mAs***	***kV-mA-s***
kV 		 	
kV-mAs 	 		 
kV-mA-s 	 	 	

4.3.2 Making X-ray exposures

What you have to do …	… and what happens
 Select auxiliary	• The LED is lit
Select focal spot only while two focal spots are available and VARIOFOCUS (optional)	
Select measuring field	• The LED lights up in the fields selected. • If you switch OFF all the measuring fields, goes out.
Enter exposure data	•  (Example)
If necessary, adapt exposure data to the thickness of the patient's body	• Depending on programming by Customer Service the following are adapted for each individual auxiliary: – kV and mAs in dose-equivalent increments – density in increments of 6%, 12%, 25%
Position patient	
Collimate!	
 Release preparation (step 1)	• goes out briefly
Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three a minute; this increases the life of the X-ray tube)	• is lit • Preparation/exposure or fluoroscopy can also be indicated visually (optional)
You can also press the button straight through to step 2. After the preparation time the exposure is released.	After exposure • There is an audible signal • goes out • The exposure data remain intact • Post-exposure display appears for 25 s. To call up the post-exposure display again press .

4.4 Operation with APR, without AEC

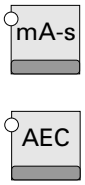
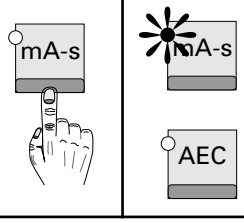
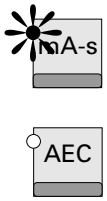
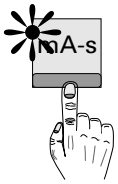
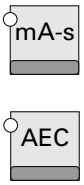
4.4.1 Exposure techniques

The following exposure techniques are available:

– kV-mAs technique
– kV-mAs-s technique
– kV-mA-s technique

The table on the right shows you how to switch between the individual techniques.

During installation the kV-mAs technique and the kV-mAs-s technique can be programmed as alternatives.

<table>
<tr><th>Initial state</th><th colspan="3">Switch over to</th></tr>
<tr><td></td><td colspan="2">kV-mAs or
kV-mAs-s*</td><td>kV-mA-s</td></tr>
<tr><td>kV-mAs or
kV-mAs-s*
  </td><td colspan="2"></td><td>  </td></tr>
<tr><td>kV-mA-s
  </td><td>  </td><td>  </td><td></td></tr>
</table>

*Depending on APR programming by Customer Service

During installation the generator is equipped with APR records from a library.

- You can select a programme from a **list** of APR programmes

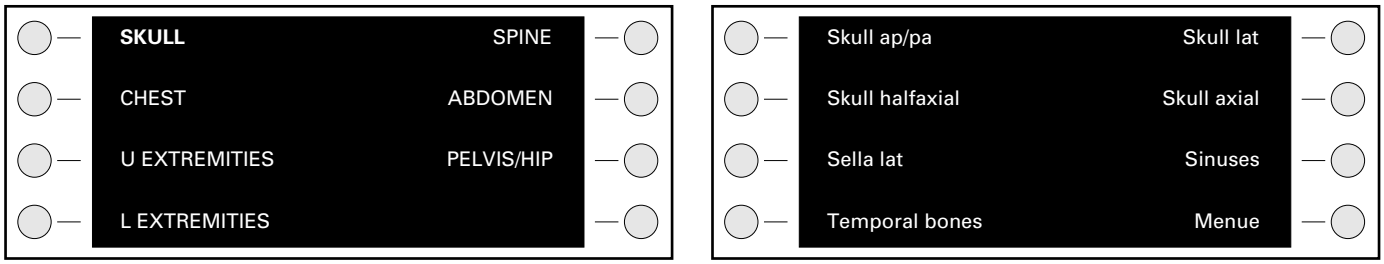
or

- you can select a programme from a **group** of APR programmes.
  Groups are APR programmes collected according to regions of the body, which then appear on the display under the generic term, the name of the group.

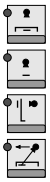
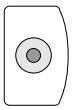
In addition you can change the exposure data of the programme selected.

4.4.2 Selecting a programme from a group of programmes (if saved)

Example

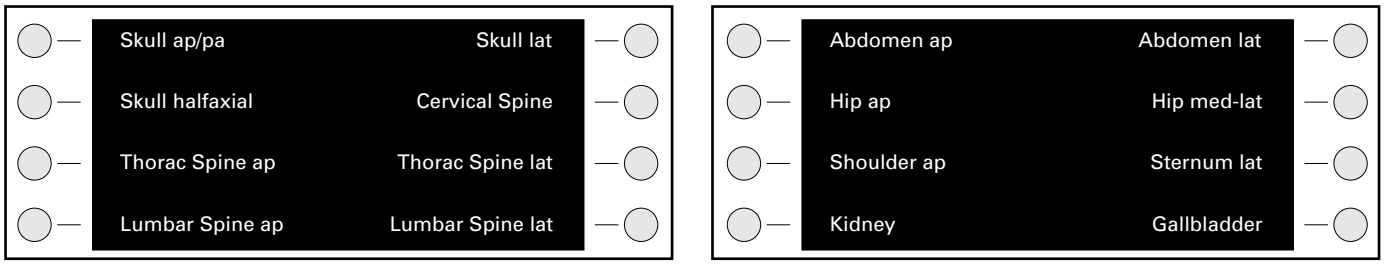


The left-hand illustration shows the regions of the body.
If, as highlighted, you select "Skull", the display of APR programmes appears, as shown in the right-hand illustration.

What you have to do …	**… and what happens**
 Select an auxiliary	• The LED lights up • The last APR setting selected appears
Press Menue —◯	• The groups assigned to that auxiliary appear
◯ Select group	• The names of the APR programmes assigned appear: • If there are more programmes than can be displayed, lights up; with you can switch between pages.
◯ Select APR programme	• The name of the programme is **highlighted** and the appropriate exposure data appear. If you do not select any APR programme after selecting a group the name of the last programme selected is **highlighted** after pressing the exposure switch; the appropriate exposure data remain valid.
Position patient	
Collimate!	
 Release preparation (step 1) Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• goes out briefly • lights up • Preparation/radiography or fluoroscopy can be indicated visually (optional).
You can also press the button straight through to step 2. After the preparation time the exposure is released.	After exposure • there is an audible signal • goes out • the exposure data remain intact
If you wish to call up the name of the group again:	
Press Menue —◯.	

4.4.3 Selecting a programme from a list of APR programmes*

Example



What you have to do …	**… and what happens**
Select an auxiliary	• The LED lights up • The page with the last programme called up and the name of the programme is **highlighted** • If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.
Select an APR programme	• The name of the programme is **highlighted** and the corresponding exposure data appear
Position patient	
Collimate!	
Release preparation (step 1)	• goes out briefly
Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• lights up • Preparation/exposure or fluoroscopy can also be indicated visually (optional)
You can also press the button straight through to step 2. After the preparation time the exposure is released.	After exposure • there is an audible signal • goes out • the exposure data remain intact

* Customer Service can enter APR programmes according to your requirements. The local guidelines must be observed. If there are any departures, reasons must be given in writing. Other APR programmes can be filed under the buttons of an assigned module.

4.4.4 Overriding exposure data of an APR programme

Please refer to the section "Radiation Protection". If there are any departures from the procedure specified by the German General Medical Council regarding quality assurance in radiodiagnostics, reasons must be given in writing.

What you have to do … **… and what happens**

You can change:

Focal spot

only where there are two focal spots available and VARIOFOCUS (optional)

Measuring field

- If you switch OFF all the measuring fields, the automatic exposure control shuts down, i.e. AEC goes out. Switch AEC back on again and select measuring field

Exposure voltage — 70 kV — with ⊖ ⊕ change the exposure voltage

mAs value — 25 mAs — with ⊖ ⊕ change the mAs value

Exposure current — 25 mA — with ⊖ ⊕ change the exposure current

Film/screen combination

- Only possible with automatic exposure control:

G200ST — with ⊖ ⊕ change the SFC (up to 5 SFCs per auxiliary. You will find suggestions in section 8.3)

Exposure time — 50 ms

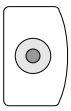
– press ⊖ ⊕ to change the exposure time
  – not for tomography auxiliaries with automatic tomographic time input
  – not for the kVmAs technique

If you have changed the data of a programme, an asterisk appears after the name of the programme (see section 2.4).

Example: Rectum*

Position patient

Collimate!



Release preparation (step 1)

- goes out briefly

Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)

- lights up
- Preparation/exposure or fluoroscopy can also be indicated visually (optional)

You can also press the button right through to step 2. After the preparation time the exposure is released.

After exposure

- there is an audible signal
- goes out
- For exposures without automatic exposure control, the exposure data remain intact
- For exposures with automatic exposure control, the post-exposure display appears for 25 s.

The data overwritten remain intact (even if you change auxiliaries, for example) until you select the same programme again or a different one.

You have the opportunity to repeat the exposure with the same exposure data but without automatic exposure control:

Switch off AEC

The exposure data last used appear.

4.4.5 Saving overridden data

Press Reset and the button ◯ of the required APR programme in this sequence and hold them down for longer than 2 s.

The asterisk disappears and the data changed are saved.

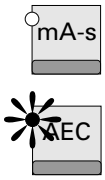
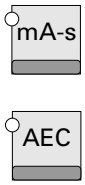
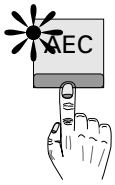
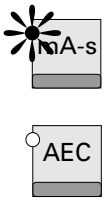
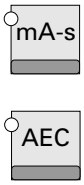
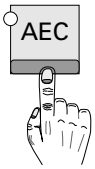
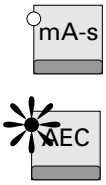
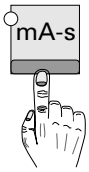
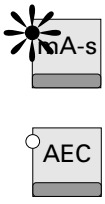
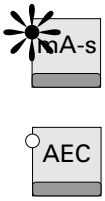
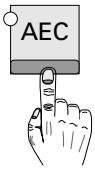
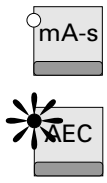
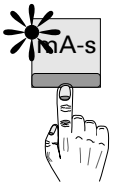
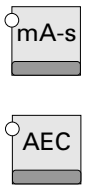
If required Customer Service can prevent the possibility of saving data which have been changed.

4.5 Operation with AEC and APR

4.5.1 Exposure techniques

The following exposure techniques are available:
– kV technique
– kV-mA technique
– kV-mAs technique
– kV-mAs-s technique
– kV-mA-s technique.

The table below shows you how to switch between the individual techniques:

Initial state	**Switch over to**					
	kV *or* ***kV-mA***		***kV-mAs*** *or* ***kV-mAs-s****		***kV-mA-s***	
kV *or* ***kV-mA*** 						
kV-mAs *or* ***kV-mAs-s**** 						
kV-mA-s 						

* During installation the kV-mAs and kV-mAs-s techniques can be programmed as alternatives.

During installation the generator is equipped with APR data records from a library.

- You can select a programme from a **list** of APR programmes

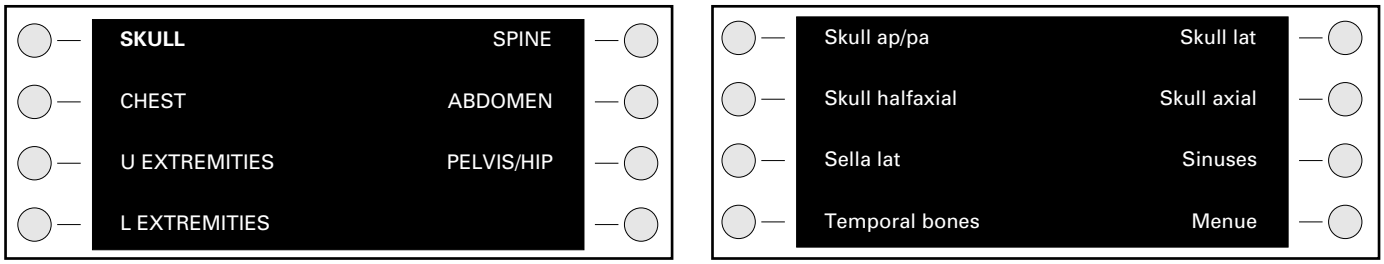
or

- You can select a programme from a **group** of APR programmes.
  Groups are APR programmes collected according to regions of the body, which then appear on the display under a generic name, the name of the group.

In addition you can change the exposure data of the programmed selected.

4.5.2 Select a programme from a group of programmes (if saved)

Example

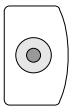


The left-hand illustration shows the regions of the body.
If you select "Skull" as highlighted, the display of APR programmes appears as shown in the right-hand illustration.

What you have to do …	**… and what happens**
Select auxiliary	• The button pressed lights up • The APR setting last selected appears
Press Menue	• The groups assigned to this auxiliary appear • The name of the group last called up under this auxiliary is **highlighted**. The exposure data appear on the display until a different programme is selected.
Select group	• The names of the APRF programmes assigned appear. • If there are more than programmes than can be shown on the display, lights up; with you can switch between the pages
Select APR programme	• The name of the programme is **highlighted** and the corresponding exposure data appear.
If necessary, adapt exposure data to the thickness of the patient's body	• Depending on programming by Customer Service the following are adapted for each individual auxiliary: – kV and mAs in dose-equivalent increments – density in increments of 6%, 12%, 25%

Position patient

Collimate!



Release preparation (step 1)

Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)

- goes out briefly
- lights up
- Preparation/exposure or fluoroscopy can also be indicated visually (optional)

You can also press the button straight through to step 2. After the preparation time the exposure is released.

After the exposure
- there is an audible signal
- goes out
- In the case of exposures without automatic exposure control the exposure data remain intact.
- In the case of exposures with automatic exposure control the post-exposure display remains for 25 s.
  If you wish to call up the post-exposure display again: press .

If you wish to call up the name of the group again:

Press Menue — .

You can repeat the exposure using the same exposure data but without automatic exposure control:

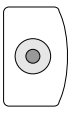
Switch off AEC

If after 25 s the post-exposure display disappears to level 2, you must first call up the post-exposure display of the last exposure and then switch AEC off.

Call up post-exposure display of the last exposure

Position patient if necessary

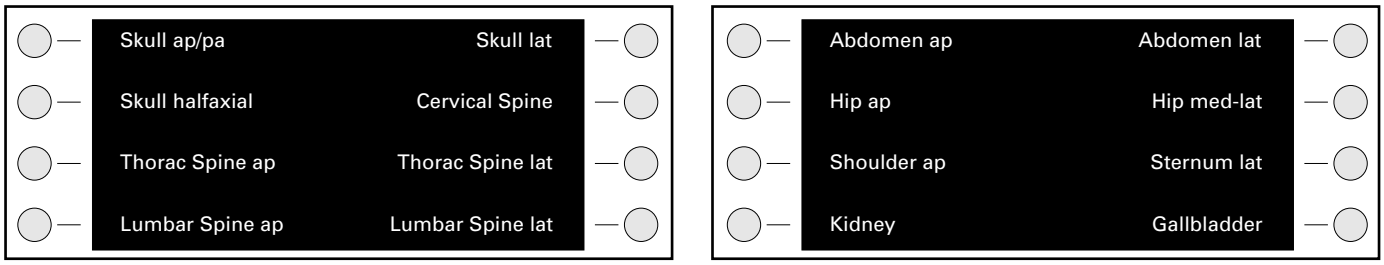
Collimate if necessary!



Release preparation and exposure (see above)

4.5.3 Selecting a programme from a list of APR programmes*

Example



What you have to do …	**… and what happens**
Select auxiliary	• The LED lights up • The page with the APR programme last called up appears and the name of the programme is **highlighted** • If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page reappears.
Select APR programme	• The name of the programme is **highlighted** and the corresponding exposure data appears; with the APR programme you do not select the respective auxiliary automatically
Position patient	
Collimate!	
Release preparation (step 1)	• goes out briefly
Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• lights up • Preparation/exposure or fluoroscopy can also be indicated visually (optional)

* Customer Service can enter APR programmes according to your requirements. The local guidelines must be observed. If there are any departures, reasons must be given in writing. Other APR programmes can be saved under the buttons of an assigned module.

You can also press the button straight through to step 2. After the preparation time the exposure is released.

After exposure

- there is an audible signal
- goes out
- In the case of exposures without automatic exposure control the exposure data remains intact.
- In the case of exposures with automatic exposure control the post-exposure display appears for 25s.

If you wish to call up the post-exposure display again press .

You can repeat the exposure using the same exposure data but without automatic exposure control:

Switch off AEC

The exposure data last used appear.

4.5.4 Overriding exposure data of an APR programme

Please refer to the section "Radiation Protection". If there are any departures from the local guidlines regarding quality assurance in radiodiagnostics, reasons must be given in writing.

What you have to do … **… and what happens**

You can change:

Focal spot

only if there are two focal spots available and VARIOFOCUS (optional)

Measuring field

- If you switch off all the measuring fields, the automatic exposure control shuts down, i.e. AEC goes out. Switch on AEC again and select measuring field.

Exposure voltage

70 kV with ⊖ ⊕ change the exposure voltage

Density correction

- Only possible with automatic exposure control:

0 ◢ with ⊖ ⊕ change the density

mAs value

25 mAs with ⊖ ⊕ change the mAs value

Exposure current

25 mA with ⊖ ⊕ change the exposure current

Screen/film combination

- Only possible with automatic exposure control:

G200ST with ⊖ ⊕ change the SFC (up to 5 SFCs per auxiliary. For suggestions refer to section 8.3)

Exposure time

50 ms

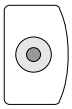
– press ⊖ ⊕ to change the exposure time
– not for tomography auxiliaries with automatic tomography time input
– not for the kV-mAs technique

If you have changed the data of a programme, an asterisk appears after the name of the programme.

Example: Rectum*

Position patient

Collimate!



Release preparation (step 1)

Release exposure (step 2, hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)

- goes out briefly
- lights up
- Preparation/exposure or fluoroscopy can also be indicated visually (optional)

You can also press the button through to step 2. After the preparation time the exposure is released.

After exposure
- there is an audible signal
- goes out
- In the case of exposure without automatic exposure control the exposure data remain intact
- In the case of exposures with automatic exposure control the post-exposure display appears for 25 s.

The data overwritten remain intact, even if you change auxiliaries for example, until you select the same programme again or a different one.

You can repeat the exposure with the same exposure data but without automatic exposure control:

Switch off AEC

The exposure data last used appear.

4.5.5 Saving overridden data

Press Reset and the ◯ button of the required APR programme in that order and hold them down for at least 2 s.

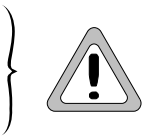
The asterisk disappears and the data which have been changed are saved.

If required, Customer Service can prevent the saving of data which have been changed.

4.5.6 Selecting exposure current for kV-mA technique

With the kV-mA technique you can select the exposure current for the next exposure. You can also program it as default according to your applicational requirements, e.g. to extend the exposure time for making an exposure of the odontoid process of the axis.

For the kV-mA technique you set the exposure current
– in the **kV-mA-s technique** direct or
– indirectly in the **kV-mAs-s technique**.
Please adhere to the sequence of steps.

What you have to do …	**… and what happens**
a. Setting via the kV-mA-s technique	
AEC Switch off AEC	• The generator switches to the kV-mA-s technique; if the generator is programmed to the kV-mAs-s technique, continue at b.
⊖ ⊕ Set exposure current	• If, for example, you reduce exposure current, the exposure time is correspondingly longer in the kV-mA technique
AEC Switch on AEC	• As a result the exposure current last set is defined **for the next exposure**; automatic exposure control regulates exposure time accordingly
If required you can save these data (section 4.4.5).	
⊖ ⊕ Set exposure time	 If you wish to save the overwritten data, you must select the exposure time before saving so that the mAs product assumes an anatomical value.
b. Setting via the kV-mAs-s technique	
AEC Switch off AEC	• The generator switches to the kV-mAs-s technique
⊖ ⊕ Set anatomical mAs	• Exposure current is set automatically via mAs*
⊖ ⊕ Set anatomical exposure time	
AEC Switch on AEC	• As a result exposure current is indirectly defined **for the next exposure**; automatic exposure control regulates exposure time accordingly
If required you can save these data (section 4.4.5).	
* If you wish to change the exposure current direct:	
mA-s Switch on mA-s	• The generator switches to the kV-mA-s technique
Continue at "a. Setting via the kV-mA-s technique" with "Set exposure current".	

4.6 Tomography

4.6.1 Making tomographic exposures without automatic exposure control (TDC)

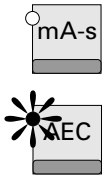
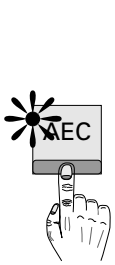
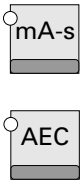
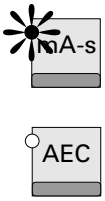
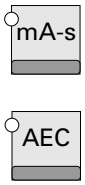
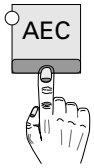
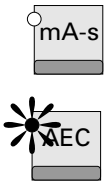
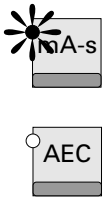
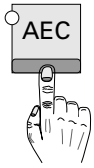
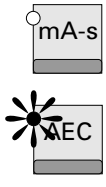
What you have to do …	**… and what happens**
Select tomography*	• The LED lights up • kV-mA-s or kV-mAs-s technique is activated. • If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.
Select APR programme	• The name of the programme is **highlighted**.
Prepare auxiliary for tomography (see Operator's Manual for the auxiliary) On the auxiliary select a tomo trajectory which matches the APR programme selected (see Operator's Manual for the auxiliary)	
Set exposure time	• Exposure time and tomographic time must agree. **If necessary, match exposure time to tomographic time.** After selecting a tomo trajectory the respective exposure time will be automatically set on the generator if – the generator is equipped with "Automatic Tomographic Time Input" (optional) and – a suitable tomography unit is connected up
Select mAs or mA (depending on the programming)	• lights up
Position patient	
Collimate!	
Release exposure (hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• goes out briefly • lights up • Preparation/exposure or fluoroscopy can also be indicated visually (optional)
	After exposure • there is an audible signal • goes out .

* If units are equipped with a remote selection feature, the generator switches over automatically to tomography if you select this mode at the unit.

4.6.2 Tomographic exposures with automatic exposure control (TDC)

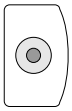
Via the option "Automatic tomographic time input" the unit transmits the specified exposure time to the generator. You cannot override it.

If you have selected tomography, the following table shows you how to switch between the individual techniques:

Initial state	Switch over to					
	TDC		***kV-mAs*** *or* ***kV-mAs-s****		***kV-mA-s***	
TDC 						
kV-mAs *or* ***kV-mAs-s**** 						
kV-mA-s 						

* During installation the kV-mAs technique and kV-mAs-s techniques can be programmed as alternatives

4.6.3 Making tomographic exposures with automatic exposure control (TDC)

What you have to do …	**… and what happens**
Select tomography*	• The LED lights up • kV-mA-s or kV-mAs-s technique is activated. • If there are more programmes than can be shown on the display, you can scroll through the pages with . After the last page the first page displayed reappears.
◯ Select APR programme	• The name of the programme is **highlighted**.
Prepare auxiliary for tomography (see Operator's Manual for the auxiliary)	• lights up
If necessary, adapt exposure data to the thickness of the patient's body	• Depending on programming by Customer Service the following are adapted for each individual auxiliary: – kV and mAs in dose-equivalent increments – density in increments of 6%, 12%, 25%
Position patient	
Collimate!	
 Release exposure (hold down button until you hear the audible signal. If you release before the signal sounds you abort the exposure. Do not press the button more than three times a minute; this increases the life of the X-ray tube)	• goes out briefly • lights up • Preparation/exposure or fluoroscopy can also be indicated visually (optional)
	After exposure • there is an audible signal • goes out .
If there has been an incorrect exposure, see section 4.6.4.	

* If units are equipped with a remote selection feature, the generator switches over automatically to tomography if you select this mode at the unit.

4.6.4 Selecting initial current for TDC

If there has been an incorrect exposure, you must correct the initial current. This can also be performed for existing programmes if the application requires.

You can set the initial current for TDC
– in the **kV-mA-s technique** direct or
– indirectly in the **kV-mAs-s technique**.
Please adhere to the sequence of steps.

What you have to do …	**… and what happens**
a. Setting via the kV-mA-s technique	
AEC Switch off AEC	• The generator switches to the kV-mA-s technique; if the generator is programmed to the kV-mAs-s technique, continue at b.
⊖ ⊕ Set initial current	
AEC Switch on AEC	• As a result the initial current last set is defined **for the next exposure**
If required you can save these data (section 4.4.5).	
b. Setting via the kV-mAs-s technique	
AEC Switch off AEC	• The generator switches to the kV-mAs-s technique*
⊖ ⊕ Set anatomical mAs	• The initial current is set automatically via mAs
AEC Switch on AEC	• As a result the initial current is indirectly defined **for the next exposure**
If required you can save these data (section 4.4.5).	

* If you wish to change the initial current direct:

mA-s Switch on mA-s	• The generator switches to the kV-mA-s technique
Continue at "a. Setting via the kV-mA-s technique" with "Set initial current".	

4.7 Fluoroscopy

4.7.1 Performing fluoroscopy

What you have to do …

… and what happens

Select fluoroscopy unit

- The LED lights up
- The names of the APRF programmes (if APR option is installed) or of the groups which have been assigned to the fluoroscopy unit appear
- Line 1, Column 2 is reserved for fluoroscopy data and is not available for APRF programmes or groups (section 3.1.5)
- The name of the APRF programme last called up under this auxiliary (if APR option is installed) or of the group last selected is **highlighted**

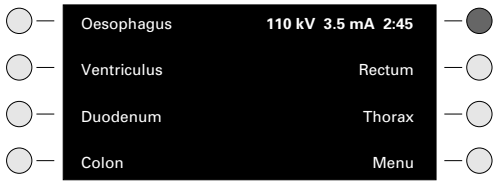
Select APRF programme

- The name of the programme is **highlighted**

Release fluoroscopy on the fluoroscopy unit (footswitch, release switch); you cannot release fluoroscopy on the generator

During fluoroscopy

- lights up
- kV and mA are controlled automatically according to the programmed fluoroscopy characteristic
- the following appear on line 1, column 2: – fluoroscopy voltage
  – fluoroscopy current and
  – fluoroscopy time in min:s
  Example:



If you cannot release fluoroscopy
– you have selected the wrong auxiliary
– an exposure is being made
– the door to the examination room is not closed or
– you have not switched off the audible signal

- there is a continuous tone after 5 min; if you fail to switch it off with within another 5 min, fluoroscopy will be shut down. Then no further action is possible until you press Reset or . Please bear in mind that Reset has more than one function (section 3.2).
- if lights up in red, the max. fluoroscopy current will be limited to 3 mA

After fluoroscopy

- goes out
- the total fluoroscopy time appears in min:s in line 1, column 2; you can delete it with Reset or . Please bear in mind that Reset has more than one function (section 3.2).

4.7.2 Exposures with image intensifier or spot-film device (SCOPOMAT)

What you have to do …	… and what happens
Select auxiliary	• The LED lights up • The names of the APRF programmes or groups assigned to this auxiliary appear • The name of the APRF programme last called up under this auxiliary or of the group last selected is **highlighted**
Select APRF programme at the generator or at the auxiliary	• The exposure data appear at the generator control desk • The name of the programme is **highlighted**
If necessary select other parameters (e.g. frame rate); for more details refer to the Operator's Manual for the auxiliary.	
Release preparation and exposure at the unit/system.	• goes out briefly
	• If you wish to make a series of exposures you must keep the release switch pressed until the end of the series.
	• lights up for each exposure
	• Preparation/exposure or fluoroscopy can also be indicated visually (optional)
	After exposure • there is an audible signal (in the series mode this depends on the frame rate)
	• goes out
	• In the case of exposures without automatic exposure control the exposure data remain intact. • In the case of series exposures with automatic exposure control the post-exposure display shows the data of the last exposure for 25 s. To call up the post-exposure display again press .

4.8 Special exposures for therapy simulation

These are only possible if the auxiliary is appropriately equipped.

What you have to do …

… and what happens

Select auxiliary for therapy simulation

- Normal fluoroscopy takes place on a different auxiliary (section 4.7)
- The LED lights up
- The names of the APRF programmes or groups assigned to this unit appear
- Line 1, column 2 is reserved for exposure data and is not available for APRF programmes of groups (section 3.1.5)
- The name of the APRF programme last called up under this auxiliary or of the group last selected is **highlighted**

Select APRF programme

- The name of the programme is **highlighted**
- kV, mA and max. exposure time are preset by the APRF programme

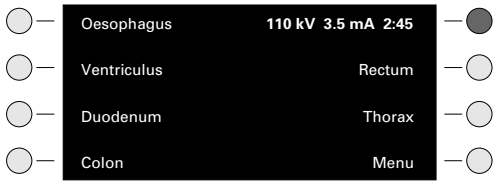
If ☰ lights up green or green and amber:*

– set fluoroscopy time to "0" with Reset or ●

– release exposure
at the system release switch for special exposure technique

During exposure

- ☢ lights up
- the following appear in line 1, column 2:
  – exposure voltage
  – exposure current and
  – exposure time +
  any accumulated fluoroscopy time
  Example:



If you cannot release an exposure
– you have selected the wrong auxiliary
– the door to the examination room is not closed or
– you have not switched off the audible signal
– ☰ lights up amber, amber + red or red. Allow the tube assembly to cool down.

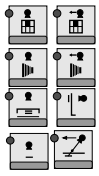
- there is an audible signal after 5 min;
  if you fail to switch it off within another 5 min with Reset or ●, exposure is shut down or interrupted. Then no further action is possible until you press Reset or ●.

After exposure
- there is an audible signal
- ☢ goes out.

* If ☰ lights up amber, amber + red or red, you cannot release the exposure. Allow the tube assembly to cool down.

4.9 Dose display (optional, depends on system)

This appears only if an auxiliary with size sensing has been selected. The computer totalises and stores the area dose products of all the exposures. If you switch examination rooms with the auxiliary, this total remains intact and is again available when you select the examination room again. The values are lost if you press ° or .

What you have to do …	… and what happens
 Select auxiliary	• The LED lights up
Call up level 3	• The total of area dose products [cGycm^2] of all exposures for the current patient in the room selected appears.
Delete dose display per tube: press Reset	
The dose display is also deleted, if – the PDO (optional, see separate Operator's Manual) reports: "End of Examination" – THORAVISION reports: "End of Examination"	

5 Maintenance

As with any technical appliance this X-ray equipment also requires
– proper operation
– regular testing by the user
– regular service and repair

By taking these precautions you maintain the operability and operational reliability of the system. As the user of an X-ray unit you are obliged according to the accident prevention regulations, the medical products law and other regulations to take such precautions.

Maintenance consists of **tests which the user can perform** and **maintenance** which is performed under service agreements, Philips service orders or by persons explicitly authorised to do so by Philips.

5.1 Tests by the user

The user must check the X-ray equipment for apparent defects (see table). If operational defects or other departures from normal operational behaviour occur, he must switch off the X-ray unit and inform Customer Service. He may only resume operation of the X-ray equipment when it has been repaired. Operation using faulty components may lead to an increased safety risk or unnecessarily high exposure to radiation.

5.2 Checking performance of dose rate control

You must check performance of the dose rate control at least once a month (XPR § 28 guidelines, IEC 60601-2-7). To do so, proceed as follows:
- Select APRF programme* (no lock-in)
- Open the diaphragm (maximum I.I. format)
- Switch on automatic kV control
- Switch on fluoroscopy
- Fluoroscopy display must be <60 kV
- Completely close diaphragm
- Fluoroscopy display must be >100 kV after approx. 2.5 s.

5.3 Safety checks according to the Medical Products Law

The safety checks cover operability and operational reliability. **They must be performed at least every 2 years**. These tests constitute part of our preventive maintenance under Philips service agreements.
They cover
– visual checking for completeness and apparent damage or defects as well as soiling, sticking parts and wear and tear which may affect safety,
– testing the necessary monitoring, safety, display and indicating systems,
– measuring the safety-relevant output parameters,
– checking electrical safety as well as the operability of an internal energy supply,
– for the particular product other special technical tests according to the generally accepted standards of engineering practice,
– other necessary tests specified by the manufacturer,
– recording results and filing the test reports in the X-ray system manual (medical products logbook).

Interval	Scope	Method
To XPR	Stability test	
Daily	Faulty display lamps, damaged components, labels and warning signs	Inspection
Weekly	All cables and terminals (damage, breakage)	Inspection
Weekly	Oil leaks and unusual noises	Inspection
Once a month	Check operation of dose rate control	s. section 5.2

* The kV-mA characteristics must be programmed by Customer Service so that the limits described can be reached.

6 Servicing

X-ray units contain mechanical components such as drive chains, ropes, steel strips and gears which are subjected to wear and tear due to operation. They include means of suspension for heavy components (e.g. image intensifier, X-ray tube assembly etc.). After a lengthy period of operation the safety of the suspension may be impaired by wear and tear (e.g. rope break).

The correct setting of the electromechanical and electronic assemblies affects the functioning, image quality, electrical safety and exposure of the patient and medical personnel to radiation.

Philips recommends
- **you to perform the tests indicated in the table on a regular basis,**
- **have the X-ray unit serviced by the Customer Service at least once a year. You must have heavily used X-ray equipment subjected to maintenance more frequently.**

In this way you avoid endangering the patient and you meet your obligations.

By entering into a service agreement with Philips you retain the value and safety of your X-ray equipment. All the necessary maintenance, including the safety tests for the purpose of preventive avoidance of danger and the necessary settings for optimum image quality and minimum exposure to radiation, are performed at regular intervals. Philips agrees on these intervals with you, taking the legal requirements into account.

6.1 Repairs

Faulty components which affect the safety of the X-ray equipment must be replaced by genuine spare parts.

6.2 Recording results

Service and repairs must be entered in the medical products logbook, including the following data:
- type and scope of work,
- if necessary, details of any changes to ratings or the working zone,
- date, person performing the work, signature.

6.3 Cleaning

Please bear the following in mind when choosing a detergent:
To clean plastic surfaces you must never use anything other than soap and water. If other detergents are used (e.g. with a high alcohol content) the material will become matt or tend to crack. Never use any corrosive, solvent or abrasive detergents or polishes.

When cleaning, please observe the following:

- Before cleaning the X-ray equipment switch off at the mains. The capacitor may still be live 4 hours after switching off.
- Ensure that no water or other liquids can enter the X-ray equipment. This precaution prevents electrical short-circuits and corrosion forming on components.
- You should wipe enameled parts and aluminium surfaces only with a damp cloth and mild detergent and then rub with a dry woollen cloth.
- Rub down chrome parts with a dry woollen cloth only.

6.4 Disinfection

The method of disinfection used must conform to the legal regulations and guidelines regarding disinfection and explosion protection.

Never use any corrosive, solvent or abrasive detergents or polishes.

If you use disinfectants which form explosive mixtures of gases, these must first have evaporated before you switch the X-ray equipment on again.

- Before disinfecting the X-ray equipment switch off at the mains. The capacitor may still be live 4 hours after switching off.
- You may disinfect all parts of the X-ray equipment, including the accessories and connecting cables, by wiping only.
- Disinfection by spraying is not to be recommended because the disinfectant may enter the X-ray equipment.
- If you perform a room disinfection with an atomizer, you must switch off the X-ray equipment first. When the X-ray equipment has cooled down, cover it over carefully with a plastic sheet. When the mist of disinfectant has subsided you can remove the plastic sheets and disinfect the X-ray equipment by wiping.

7 Technical data

7.1 Electrical data

		OPTIMUS 50	OPTIMUS 65	OPTIMUS 80
Safety class		I	I	I
EMC emission (IEC 60601-1-2/CISPR 11)		Group I/class A	Group I/class A	Group I/class A
Power supply		400 V ± 10%, 50 Hz and 60 Hz, 3-phase		
With adaption transformer (optional)		400 V ± 10%, 460 V ±10%, 480 V +5%, –10% 50 Hz and 60 Hz, 3-phase		
Main resistance	400 V	0.30 Ω, 145 A	≤0.2 Ω, ≤190 A	0.2 Ω, ≤230 A
	440 V	0.35 Ω, 135 A	0.24 Ω, 180 A	0.24 Ω, 215 A
	460 V	0.35 Ω, 125 A	0.24 Ω, 170 A	0.24 Ω, 210 A
	480 V	0.40 Ω, 120 A	0.30 Ω, 160 A	0.30 Ω, 205 A
	*480 V	0.30 Ω, 120 A	0.24 Ω, 160 A	0.18 Ω, 205 A
Line voltage regulation	400 V	11.0%	9.5%	11.5%
	440 V	10.5%	9.6%	11.7%
	460 V	9.5%	9.0%	10.9%
	480 V	10.0%	10.0%	12.8%
	*480 V	7.5%	8.0%	7.7%
	* according to DOD requirements			
Max. current input is reached under the following conditions:	– Tube power	50 kW	65 kW	80 kW
	– Technique	kV-mAs	kV-mAs	kV-mAs
	– Focal spot	large	large	large
	– High voltage	77 kV	81 kV	80 kV
	– mAs product	65 mAs	80 mAs	100 mAs
	– Exposure time	0.1 s	0.1 s	0.1 s
Electrical output (IEC 60601-2-7)				
High voltage generation		Converter	Converter	Converter
Ripple		DC voltage	DC voltage	DC voltage
Radiography	Max. voltage	150 kV	150 kV	150 kV
	Nom. electric power (100 kV; 0.1 s)	50 kW	65 kW	80 kW
	Max. electric power	50 kW	65 kW	80 kW
		650 mA at 70 kV	900 mA at 70 kV	1100 mA at 70 kV
		625 mA at 80 kV	812 mA at 80 kV	1000 mA at 80 kV
		500 mA at 100 kV	650 mA at 100 kV	800 mA at 100 kV
		400 mA at 125 kV	520 mA at 125 kV	640 mA at 125 kV
		333 mA at 150 kV	433 mA at 150 kV	533 mA at 150 kV
Fluoroscopy	Max. voltage	110 kV (125 kV)*	110 kV (125 kV)*	110 kV (125 kV)*
Continuous output (for a practical set-up consisting of fluoroscopy and radiography)		500 W (6 f/min at 50 kW; 0.1 s)	500 W (6 f/min at 65 kW; 0.1 s)	500 W (6 f/min at 80 kW; 0.1 s)

* programmable by service

Classification according to Medical Device Directive 93/42/EEC-IIb.

7 Technical data

Exposure techniques

kV, continuously falling load, automatic exposure control (one-factor technique)
kV, mA, constant current operation, automatic exposure control (two-factor technique)
TDC, automatic exposure control with tomography (dose-rate controlled tomography)
kV, mAs, constant load (two-factor technique)
kV, mAs, s, constant load (three-factor technique)
kV, mA, s, constant load (three-factor technique)

7.2 Setting ranges

		OPTIMUS 50	OPTIMUS 65	OPTIMUS 80
Radiography without automatic exposure control	Tube voltage	40 kV ... 150 kV, adjustable in steps of 1 kV or according to a sequence the steps of which roughly correspond to an exposure increment[1]. In the case of tubes with lower maximum tube voltage this is limited accordingly.		
	Tube current	For kV-mA-s and kV-mAs techniques this can be adjusted in steps of 25%[1], 12% or 6%		
		1 mA … 650 mA	1 mA … 900 mA	1 mA … 1100 mA
	mAs	0,5 mAs … 850 mAs	0,5 mAs … 850 mAs	0,5 mAs … 850 mAs
		Adjustable in steps of 25%[1], 12% or 6%		
		Compliance range as per IEC 601-2-7:		
		2.0 mAs … 850 mAs	2.0 mAs … 850 mAs	2.0 mAs … 850 mAs
	Exposure times	1.0 ms … 6 s (16 s) adjustable in steps of 25%[1], 12% or 6%		
Radiography with automatic exposure control	mAs[2]	0.5 mAs … 600 mAs	0.5 mAs … 600 mAs	0.5 mAs … 600 mAs
	Switching times	1.0 ms … 4 s	1.0 ms … 4 s	1.0 ms … 4 s
	Density corr.	Adjustable in steps of 25%, 12%[1] or 6%		
Tomography	mAs	0.5 mAs … 850 mAs	0.5 mAs … 850 mAs	0.5 mAs … 850 mAs
		in steps of 25%, 12% or 6%		
	Switching times	1.0 ms … 6 s (16 s)	1.0 ms … 6 s (16 s)	1.0 ms … 6 s (16 s)
		in steps of 25%, 12% or 6%		
Tomography with automatic exposure control (TDC)	mAs	0.5 mAs … 600 mAs	0.5 mAs … 600 mAs	0.5 mAs … 600 mAs
		in steps of 25%, 12% or 6%		
	Switching times	1 ms … 6 s	1 ms … 6 s	1 ms … 6 s
Fluoroscopy	Tube voltage	40 kV … 125 kV, via kV/mA characteristics		
	Tube current	0.1 mA … 6 mA, via kV/mA characteristics		
Radiography for therapy simulation	Tube voltage	40 kV … 141 kV		
	Tube current	0.2 mA … 20 mA		
	Time	65 s		

7.3 Ambient conditions for operation

Temperature	10 °C … 40 °C
Rel. humidity	15% … 90%, no condensation
Atmospheric pressure	70 kPa … 110 kPa

1) Default values: ±25% mAs corresponds to ±1 exposure density step
±12% density correction corresponds to ±0.5 exposure density steps
2) The maximum mAs value can be set lower by the Customer Service

7.4 Accuracy of the operating data, tolerances

1. Compliance

with the requirements of IEC 60601-2-7 applying the IEC test conditions.

Current-time reference product

Reference value for the compliance range of linearity of the emitted radiation.
This table applies to tubes with X-ray generator nominal power and an exposure time of 100 ms at 100 kV. For tubes with a lower focal spot power the current-time reference product has to be converted accordingly.

	Current-time reference product		
	50 kW	65 kW	80 kW
70 kV, 320 mA 70 kV, 400 mA 70 kV, 500 mA	32 mAs	40 mAs	50 mAs
100 kV, 250 mA 100 kV, 320 mA 100 kV, 400 mA	25 mAs	32 mAs	40 mAs
150 kV, 160 mA 150 kV, 200 mA 150 kV, 250 mA	16 mAs	20 mAs	25 mAs

Requirement	**Compliance**
Exposure	
• Reproducibility of emitted radiation	complies
• Linearity of limited radiation	
a) in relation to current-time product	in the range of > 2 mAs
b) assuming consecutive settings or settings with a factor of < 2	over the entire range of settings
• Consistency of emitted radiation during automatic exposure control	complies
• Accuracy of the X-ray tube load factors Tube voltage Tube current Tube load time Current-time product Current-time reference product	complies
Fluoroscopy	
• Accuracy of tube load factors Tube voltage Tube current	complies complies

2. Tolerances of the indicated X-ray tube load factors

Exposure

Typical range of application

Tube voltage	±5%, additional ±1 kV
Tube current-time product	±3%, additional ±0.5 mAs
Tube current	±5%, additional ±0.5 mA
mAs post-exposure display in kV technique	±3%, additional ±0.5 mAs
Post-exposure time display	±3%, additional ±0.5 ms
Exposure time	
• OPTIMUS 50:	±5%, additional ±0.5 ms
– for I<10 mA	±5%, additional ±25 ms
• OPTIMUS 65/80:	±5%, additional ±0.5 ms
– for I<10 mA	±5%, additional ±25 ms
– for I≤ 2 mA	±5%, additional +25 ms –85 ms

Fluoroscopy

Typical range of application

Tube voltage	±5% in addition ±1 kV
Tube current	±5% in addition ±0.1 mA

7.5 Compatibility

You can operate any OPTIMUS with RO and SRO tubes from Philips. Mixed operation is possible.

Philips recommends the following standard tubes:
RO 1648
RO 1750
SRO 0951
SRO 2550
SRO 33100

For other tubes which can be connected up consult the Customer Service.

You can connect the Patient Data Organiser (PDO) up to any OPTIMUS. For more information please contact your Philips representative.

7.6 Methods of measurement

X-ray tube voltage

Tube voltage is measured with the aid of balanced high-voltage bleeders in the high-voltage circuit.

X-ray tube current

Tube current is measured on the cathode side in the rectified high-voltage circuit of the X-ray generator (100 ms section).

Load time

Load time is measured between 75% ±7.5% peak voltage of the high-voltage rise edge and 75% ±7.5% peak voltage of the high-voltage fall edge.

Current-time product

Current-time product is measured on the cathode side in the rectified high-voltage circuit of the X-ray generator.

7.7 Type number plate

All labels are located on a label bracket at the top left corner of the front side of the cabinet, visibly marked by (for information).

If you swivel the label bracket 90° to the right the following labels will appear at its bottom side:

- X-RAY CONTROL (control unit) with indication of power class, serial number, type number and the name and the address of the manufacturer
- X-RAY H.V. GENERATOR (high-voltage generator) with indication of power class, type number, serial number and the name and address of the manufacturer
- Technical data label
- Date of manufacture
- Certification label.

8 Appendix

8.1 Error messages

Text	Meaning	Action
Door open	The door to the examination room is not closed	Close door
XXXX Press RESET	This message appears if, for example, there are mains voltage fluctuations. The error code XXXX is intended for Customer Service.	Clear message: press Reset The generator is ready for operation
03HJ Press Reset	The focal spot selected has failed. You can proceed using a different focal spot.	Press Reset
Press power on	Initialisation phase has been disrupted	Press ° again
15LH	During startup the footswitch has been pressed	Do not press the footswitch during startup

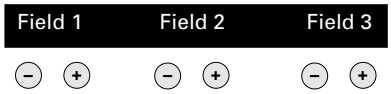
8 Appendix

8.2 The hierarchy of levels on the display

There is more information than the display can give at a single level. The information which is not visible is filed in three further levels and can be displayed with . Each time you press the button you call up the next level. After level 4, level 1 reappears. If after an error message you have switched the generator off and back on again, you can call up this error message on level 4.

The following table tells you where you can find the several information:

Exposure techniques	Field *	Display on level 1	Display on level 2	Display on level 3	Display on level 4
with Automatic Exposure Control	1	kV	kV	1)	Message
	2	Density correction	mAs or mA (post-exp. display)		Message
	3	Screen-film combination	s (post-exp. display)		Message
kV-mAs	1	kV	kV	1)	Message
	2	mAs	mA (calculated)		Message
	3	s	2)		Message
kV-mAs-s	1	kV	kV	1)	Message
	2	mAs	mA (calculated)		Message
	3	s	2)		Message
kV-mA-s	1	kV	kV	1)	Message
	2	mA	mAs (calculated)		Message
	3	s	2)		Message
TDC	1	kV	kV	1)	Message
	2	Density correction	mAs oder mA (post-exp. display)		Message
	3	Screen-film combination	s (programmed)		Message

* 

1) Total area of dose products (optional) in cGycm^2 per examination room and patient

2) The recommended screen-film combination is displayed. You cannot change the value. Apart from the precalculated value you can set all the values on the control desk.

8.3 Screen-film combinations

Philips suggests the following designations

– G200ST
– U400SP
– B100HR
– G200+–

Bedeutung der Bezeichnungen:

– G Green
– U Ultraviolet
– B Blue
– ST Standard
– SP Special
– HR High resolution
– + Graduated intensifying screen
– – Graduated intensifying screen
– 100…400 Absolute screen speed

If required the Customer Service can programme different names (6 characters max.).

8.4 The symbols and their meanings

The symbols on the buttons can be exchanged by Customer Service if required.

Horizontal radiographic device

Tiltable examination device with overtable cassette

Angiography and Puck

Tiltable examination device with undertable tube assembly and cassette

Tomography device

Fluoroscopy table with undertable tube assembly and image intensifier

Tiltable examination device with undertable tube assembly and image intensifier

Spot-film device

Spot-film device, tomography

DSI

DSI, tomography

Show vessels

Fluoroscopy

Bolus chase in lower extremities

Skull unit

Kymography

Free cassette, room 2

Wall column, room 2

8 Appendix

8.5 Exposure table

Part of body	Cassette size	cm	kV	mAs	AMPL. ○□○	SID [cm]	Focus ▫□□	SC [DIN]	Grid
Skull and trunk									
Zygo. arch., Henkeltopf	18 x 24	20	73	8		110	▪	200	
Skulll ap/pa	24 x 30	20	77	16	■	110	▪	400 (200)	+
Skull lateral	24 x 30	16	73	8	■	110	▪	400 (200)	+
Clementschisch/Towne	24x30	26	81	25	■	110	▪	400 (200)	+
	(18x24 landscape)								
Schüller/Stenvers	18 x 24	24	77	25	■	110	▪	400 (200)	+
Rheese/Orbita	18 x 24	19	73	16	■	110	▪	400 (200)	+
Pyramis comparison	18 x 24	22	77	16	■	110	▪	400 (200)	+
Skull axial	24 x 30	28	85	32	■	110	▪	400 (200)	+
Paranasal sinuses, semiaxial	18 x 24 (13 x 18)	22	77	40	■	110	▪	400 (200)	+
Nasal bone	18 x 24	3	44	2,5		110	▪	200	
Cervical spine ap	18 x 24	10	66	25	■	110	▪	400 (200)	+
Cervical spine lateral/oblique	18 x 24	12	73	25	■	150	▪	400 (200)	+
Dorsal spine ap (- +)	30 x 40	21	77	25	■	110	■	400	+
Dorsal spine lateral (+ -)/(+ - +)	30 x 40	32	81-85	40	■	110	■	400	+
Lumbar spine ap	30 x 40	22	77	25	■	110	■	400	+
Lumbar spine lateral (- +)/obl.	24 x 30	36	90-96	32	■	110	■	400	+
Sacrum lateral	18 x 24 (13 x 18)	28	90	40	■	110	■	400	+
Hip ap	24 x 30	20	77	20	■	110	■	400	+
Hip axial/Lauenstein	24 x 30	22	77	25	■	110	■	400	+
Ala-/obturatum exposure	24 x 30	24	77	25	■	110	■	400	+
Sacro iliac joint	18 x 24	22	81	20	■	110	■	400	+
Pelvis ap	35 x 43 (30 x 40)	20	77-85	12,5	● ●	110	■	400	+
Thorax pa	35 x 43	18	125	2	● ●	180	▪	400 (200)	+
Thorax lateral	35 x 43	26	125	3,2	■	180	■	200	+
Thorax recumbent (bed)	35 x 35 (40 x 40)	21	102	1		110	▪	400 (200)	
Ribs 1-7	30 x 40 (24 x 30)	16	66	20	■	110	▪	400 (200)	+
Ribs 8-12	30 x 40 (24 x 30)	20	77	16	■	110	■	400 (200)	+

All data are only recommendations and apply to normal patients (75 kg, 175 cm).

Site:.....

Part of body	Cassette size	cm	kV	mAs	AMPL. ○□○	SID [cm]	Focus ▫□□	SC [DIN]	Grid
Abdomen									
Oesophagus	24 x 30		90		■		■	400	+
Stomach	35 x 35		102		■		■	400	+
Stomach detail	24 x 30 (18 x 24)		117		■		■	400	+
Small intestine (Sellink)	35 x 35 (24 x 30)		109		■		■	400	+
Colon	35 x 35		117		● ■ ●	150	■	400	+
Colon			109		■		■	400	+
Colon detail	24 x 30 (18 x 24)		125		■		■	400	+
Abdomen	35 x 43 (30 x 40)		85		● ■ ●		■	400	+
Abdomen side pos.	35 x 43 (30 x 40)		90-102		■		■	400	+
Kidneys empty	35 x 43 (30 x 40)		77		■		■	400	+
Kidneys + contrast medium	35 x 43 (30 x 40)		85		■		■	400	+
Kidneys detail	24 x 30		81		■		■	400	+
Ureter	20 x 40 (24 x 30)		77		■		■	400	+
Urethra	18 x 24		73		■		■	400	+
Bladder ap	18 x 24		77		■		■	400	+
Bladder lateral	18 x 24		90		■		■	400	+
Gallbladder empty	24 x 30 (18 x 24)		70		■		■	400	+
Gallbladder + contrast medium	24 x 30 (18 x 24)		77-85		■		■	400	+
Gallbladder detail	18 x 24		73		■		■	400	+
Phlebographies									
Pelvis	35 x 35 divid. in 3		77		■		■	400 (200)	+
Femur	35 x 35 divid. in 3		73		■		■	400 (200)	+
Lower leg	35 x 35 divid. in 3		66		■		■	400 (200)	+

8 Appendix

Exposure table

Part of body	Cassette size	cm	kV	mAs	AMPL. ○□○	SID [cm]	Focus ▫□□	SC [DIN]	Grid
Upper extremities									
Finger	13 x 18	1.5	46	2		110	▪	200	
Thumb	13 x 18	3	46	3,2		110	▪	200	
Hand ap	18 x 24	3	46	3,2		110	▪	200	
Hand (zither player)	18 x 24	4	48	3,2		110	▪	200	
Wrist ap	18x24 divid. in 2	5	48	4		110	▪	200	
Wrist lateral	18x24 divid. in 2	6	50	4		110	▪	200	
Navicular series ap/obl./lat.	24x30 or 18x24	6-7	50	3,2-5		110	▪	200	
	divid. in 4							200	
Forearm + wrist ap	18 x 24	7	52	4		110	▪	200	
Forearm + wrist lateral	18 x 24	8	52	5		110	▪	200	
Forearm + elbow ap	24 x 30 (18 x 24)	8	55	4		110	▪	200	
Forearm + elbow lateral	24 x 30 (18 x 24)	9	55	5		110	▪	200	
Elbow ap	18 x 24	9	55	5		110	▪	200	
Elbow lateral	18 x 24	10	55	6,4		110	▪	200	
Humerus + elbow ap	24x30 divid. in 2	11	60	6,4		110	▪	200	
Humerus + elbow lateral	24x30 divid. in 2	12	60	6,4		110	▪	200	
Humerus + shoulder ap	24 x 30 (18 x 24)	13	66	10	■	110	▪	200 (400)	+
Humerus + shoulder lateral	24 x 30 (18 x 24)	13	66	12	■	110	▪	200 (400)	+
Shoulder ap	18 x 24	16	66	32	■	110	▪	200 (400)	+
Shoulder axial	18 x 24	16	66	32	■	110	▪	200 (400)	+
Shoulder transthoracal	18 x 24	26	85/90	25	■	110	■	200 (400)	+
Clavicle	18 x 24	14	66	10	■	110	▪	200	+
Sternum lateral	24 x 30	42	85	8	■	110	■	200 (400)	+
Sternum oblique	24 x 30	21	77	16	■	110	■	200 (400)	+
Scapula ap	18 x 24	17	70	10	■	110	▪	200 (400)	+

All data are only recommendations and apply to normal patients (75 kg, 175 cm).

Site:.....

Part of body	Cassette size	cm	kV	mAs	AMPL. ○□○	SID [cm]	Focus ▫□□	SC [DIN]	Grid
Lower extremities									
Toes	18 x 24 (13 x 18)	2	46	2,5		110	▪	200	
Forefoot ap	18 x 24	3	48	2,5		110	▪	200	
Forefoot oblique	18 x 24	4	48	3,2		110	▪	200	
Foot ap	18 x 24	5	50	3,2		110	▪	200	
Foot oblique	18 x 24	6	50	5		110	▪	200	
Lower ankle ap	18x24 divid. in 2	9	55	5		110	▪	200	
Lower ankle oblique	18x24 divid. in 2	7	52	4		110	▪	200	
Upper ankle ap	18x24 divid. in 2	9	55	5		110	▪	200	
Upper ankle lateral	18x24 divid. in 2	8	55	4		110	▪	200	
Calcaneum axial	18x24 divid. in 2	11	55	6,4		110	▪	200	
Calcaneum lateral	18x24 divid. in 2	8	52	4		110	▪	200	
Lower leg + upper ankle ap	20 x 40	9	57	4		110	▪	200	
Lower leg + upper ankle lateral	20 x 40	8	57	3,2		110	▪	200	
Lower leg + knee ap	20 x 40	11	60	5		110	▪	200	
Lower leg + knee lateral	20 x 40	10	60	4		110	▪	200	
Knee ap	18 x 24	11	66	5	■	110	▪	200 (400)	+
Knee lateral	18 x 24	10	66	4	■	110	▪	200 (400)	+
Patella axial + Défilé	13 x 18	12	63	8		110	▪	200	
Frik	13x18 oder18x24 special cassette	13	63	10		110	▪	200	
Femur + knee ap/lateral	20 x 40	14	66	2	■	110	▪	200 (400)	+
Femur + hip ap	20 x 40	16	73	20	■	110	■	400	+
Femur + hip lateral	20 x 40	16	73	25	■	110	■	400	+
Hip ap	24 x 30	20	77	20	■	110	■	400	+
Hip Sven Johansson	24 x 30	20	81	10		110	■	400	
Hip axial/Lauenstein	24 x 30	22	77	25	■	110	■	400	+
Pelvis ap	35 x 43 (30 x 40)	20	77-85	12,5	● ●	110	■	400	+

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8.6 For quick reference

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8.7 Abbreviations and their meanings

AEC	Automatic Exposure Control
APR	Anatomically Programmed Radiography
APRF	Anatomically Programmed Radiography and Fluoroscopy
DSI	Digital Spot Imaging
f/min	Frames per minute
II	Image intensifier
PDO	Patient Data Organizor
SFC	Screen-film combination
SID	Source-Image distance
TDC	Tomography Density Control
THORAVISION	Lung unit

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Printed in Germany. 4512 109 24972 Rev. AA/742H * 07.2002

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